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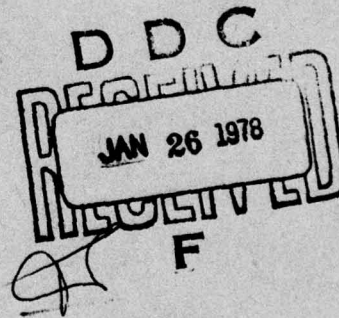


# USAF BIOENVIRONMENTAL NOISE DATA HANDBOOK

Volume 41

A-7D In-Flight Crew Noise

OCTOBER 1976



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AEROSPACE MEDICAL RESEARCH LABORATORY  
AEROSPACE MEDICAL DIVISION  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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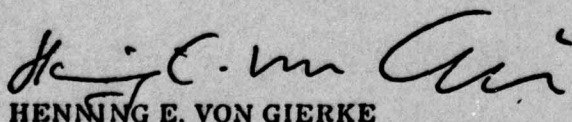
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FOR THE COMMANDER

  
HENNING E. VON GIERKE  
Director  
Biodynamics and Bionics Division  
Aerospace Medical Research Laboratory



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protectors. Refer to Volume 1 of this handbook, ~~USAF Bioenvironmental Noise~~ Data Handbook, Vol. 1: Organization, Content and Application, ~~AMRL-TR-75-~~ 50(1) 1975, for discussion of the objective and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. ↑

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## **PREFACE**

This report was prepared by the Biodynamic Environment Branch, Aerospace Medical Research Laboratory, under Project/Task 72310418, Measurement of Noise and Vibration Environments of Air Force Operations.

The author acknowledges the efforts of John N. Cole who established the data analysis requirements and assisted in the preparation of this report, and Henry Mohlman and David Eilerman of the University of Dayton who assisted in the mechanics of data processing.



## PREFACE

This report was prepared by the Human Environment Branch, Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, in fulfillment of the contract task assigned by the Air Force Office of Scientific and Technical Research, Dayton, Ohio, under contract number AF33(616)-75-1-1001.

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## INTRODUCTION

The A-7D is a single-seat tactical fighter manufactured by the LTV Aerospace Corporation. Power is provided by one TF41-A-1 turbofan engine rated at 14,250 lb maximum takeoff thrust. The engines are manufactured by the Detroit Diesel Allison Division, General Motors Division.

This volume provides measured data defining the bioacoustic environments produced inside the aircraft. Such data are essential to evaluate ear protection requirements, limiting personnel exposure times, voice communication capabilities, and annoyance problems associated with operations of the A-7D aircraft.

This volume is one of a series published by the Aerospace Medical Research Laboratory (AMRL) under the same report number (AMRL-TR-75-50) as a multi-volume handbook that quantifies the noise environments produced at flight/ground crew locations and in surrounding communities by operations of Air Force aircraft and ground support equipment. The far-field, community-type noise data in the handbook describe the noise produced during *ground operations* of aircraft, ground support equipment, and other ground-based equipment or facilities.

Volume 1 of this handbook discusses the objectives and design of the handbook, the types of data presented, measurement procedures, instrumentation, data processing, definitions of quantities, symbols, equations, applications, limitations, etc. *Refer to Volume 1* (reference 1) for such information because it is not repeated in other handbook volumes.

A cumulative index lists those aerospace systems contained in the handbook, and identifies the specific volumes containing each type of environmental noise data available (i.e., inflight/flight crew and passenger noise, near-field/ground crew noise, far-field/community noise). Volume numbers are assigned sequentially as individual volumes are published. This index is periodically updated as individual volumes are published and is available upon request from AMRL/BBE, Wright-Patterson AFB, OH 45433. Organizations on the distribution list for the handbook will automatically receive a copy of each updated index as it is generated.

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1. Cole, John N., *USAF Bioenvironmental Noise Data Handbook, Volume 1: Organization, Content and Application*, AMRL-TR-75-50 (1), Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, 1975.



## IN-FLIGHT NOISE

### MEASUREMENTS

All noise measurements were made on-board an A-7D aircraft during typical speed, altitude, and flight maneuver conditions. These levels describe the standard A-7D environments, but may not be representative of those levels encountered if the aircraft has been configured differently (e.g., major equipment or structural changes.)

Acoustic measurements were made inside the cockpit at the pilot's location with MICROPAK, a small in-flight recording system worn by the pilot. The miniature electret condenser microphone was attached to the pilot's helmet on a light-weight boom and positioned at ear level 0.1 meter from the helmet's surface with its diaphragm parallel to the surface pointing away from the helmet. Table 1 lists the measurement location and test conditions as numeric/alphabetic designators which are used on the data pages. The designator 1/A means measurement location 1 and test condition A.

In the analysis, microphone corrections for random incidence were applied to the overall systems response. The recorded samples were analyzed using a four or eight sec integration time to obtain power-averaged levels that effectively smooth out short-duration fluctuations and best describes the exposure.

### RESULTS

The measured data presented in Table 2 define the sound pressure levels (SPL) produced inside the A-7D aircraft at the specified location. This table includes the overall, 1/3 octave band, and octave band levels. From these data, C-weighted and A-weighted sound levels maximum permissible time for one exposure per day (AFR 161-35) with and without standard Air Force ear protectors, preferred speech interference level, and perceived noise level are calculated and presented in Table 3. These measures are widely used to assess the effects of noise on personnel and their performance.

**TABLE 1**  
**MEASUREMENT LOCATIONS AND TEST CONDITIONS**

A-7, EDWARDS AFB, CA — 17 APRIL 1976

<i>LOCATION</i>	<i>POSITION</i>	<i>HEIGHT ABOVE DECK</i>
1	Cockpit	Seated Head Level
<i>CONDITION</i>	<i>DESCRIPTION</i>	
A	Idle — 53% RPM, Canopy Open	
B	Taxi — Canopy Open	
C	Takeoff — Full Military Power	
D	Climb to 5000' MSL — Military Power	
E	Climb to 15000' MSL — Military Power	
F	Climb to 20000' MSL — Military Power	
G	Climb to 23000' MSL — Military Power	
H	Climb to 25000' MSL — Military Power	
I	Climb to 30000' MSL — Military Power	
J	Cruise — .76M, 88% RPM, 30000' MSL	
K	Cruise — .76M, 88% RPM, 30000' MSL — DEFOG ON	
L	Cruise — .76M, 88% RPM, 30000' MSL — DEFOG OFF	
M	Simulated Weapon Delivery — 500 KIAS	
N	Pull Up — Full Mil Power	
P	Weapon Delivery — 45° Dive Angle	
R	Weapon Release — 480 KIAS	
S	Simulated Traffic Pattern — 13000' MSL	
T	Turn to Simulated Base — Gears and Flaps Down	
U	High Speed Run — 1000' AGL, 540 KIAS	
V	High Speed Run — 3000' AGL, 540 KIAS	
W	High Speed Run — 50' AGL, 540 KIAS	
X	Normal Traffic Pattern — Gear and Flaps Down	
Y	Touchdown and Roll	

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)

1/3 OCTAVE BAND

2

NOISE SOURCE/SUBJECT: ( OPERATION: )

A-7D AIRCRAFT

INFLIGHT NOISE LEVELS

IDENTIFICATIONS

OMEGA 3.2

TEST 76-407-001

RUN 01

13 SEP 76

PAGE F1

LOCATION/CONDITION

FREQ (HZ)	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L
50	89	93	91	84	79	75	73	73	72	72	74	72
63	83	90	93	85	81	82	77	77	77	76	78	78
80	88	89	95	86	82	83	78	80	79	80	80	81
100	88	89	96	84	86	86	81	81	80	82	85	83
125	80	87	91	85	87	86	82	81	80	82	85	81
160	83	84	95	87	91	91	88	87	87	87	91	88
200	84	82	96	90	90	91	88	88	88	88	88	89
250	86	80	95	92	91	91	88	88	88	88	87	89
315	77	78	97	91	93	93	91	91	90	90	91	91
400	80	76	98	94	94	94	94	94	92	92	93	93
500	84	77	96	93	93	93	92	91	90	89	90	92
630	82	74	97	92	94	94	93	93	91	90	92	92
800	82	76	99	96	96	95	93	93	93	93	94	94
1000	85	86	99	96	97	96	93	92	93	93	94	94
1250	91	92	98	96	97	95	91	91	89	90	93	93
1600	80	76	96	93	94	92	88	88	87	88	90	90
2000	81	74	96	93	95	93	89	88	87	88	90	89
2500	83	78	97	95	95	100	95	93	91	91	94	94
3150	81	77	99	95	95	98	90	91	92	91	98	90
4000	84	79	106	109	104	98	86	86	89	94	97	94
5000	83	80	100	101	100	91	83	85	85	86	94	89
6300	82	80	102	100	99	94	83	84	87	88	95	89
8000	82	75	103	98	100	93	82	82	85	87	94	89
10000	86	73	101	98	98	92	83	83	85	86	92	88
OVERALL	99	99	113	111	110	107	103	103	102	103	106	104

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.



TABLE: MEASURED SOUND PRESSURE LEVEL (DB)													IDENTIFICATION:	
1/3 OCTAVE BAND														
2													OMEGA 3.2	
NOISE SOURCE/SUBJECT: ( OPERATION: )													TEST 76-407-001	
A-70 AIRCRAFT ( )													RUN 02	
INFLIGHT NOISE LEVELS ( )													13 SEP 76	
( )													PAGE F2	
LOCATION/CONDITION														
FREQ (HZ)	1/M	1/N	1/P	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y			
50	81	81	83	80	85	80	80	80	82	83	85			
63	84	84	86	82	87	85	84	83	86	85	91			
80	91	86	91	85	89	88	85	84	88	86	96			
100	91	88	95	92	92	84	87	89	91	91	88			
125	87	87	91	89	89	82	88	89	94	90	84			
160	92	91	96	95	95	87	93	94	96	95	87			
200	97	98	101	94	94	91	94	92	96	99	87			
250	100	98	100	96	95	90	94	94	97	99	85			
315	105	99	101	99	100	92	98	97	100	100	86			
400	102	104	104	99	99	91	100	99	102	101	85			
500	104	101	105	99	99	90	99	100	104	103	84			
630	102	99	102	98	99	90	100	100	105	100	79			
800	102	101	104	102	101	90	103	104	108	100	78			
1000	102	100	103	102	102	90	101	102	105	100	81			
1250	101	100	101	100	100	88	99	99	103	98	94			
1600	99	97	97	97	98	87	98	98	102	95	83			
2000	95	94	95	95	95	87	96	97	100	94	82			
2500	93	91	95	94	95	83	97	98	99	96	81			
3150	91	90	93	92	93	85	98	98	100	94	79			
4000	93	91	92	95	96	83	104	102	105	102	80			
5000	90	90	91	92	95	80	98	98	101	96	78			
6300	91	90	91	92	97	80	98	99	103	97	80			
8000	90	90	90	91	92	77	101	101	103	98	78			
10000	89	89	90	89	90	76	96	97	100	94	73			
OVERALL	112	111	113	110	110	101	112	112	115	111	101			
LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE														

LEVEL CORRECTED TO REMOVE BACKGROUND/ELECTRONIC NOISE.

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)														
OCTAVE BAND														
2														
NOISE SOURCE/SUBJECT: ( OPERATION: )														
( )														
A-7D AIRCRAFT ( )														
INFLIGHT NOISE LEVELS ( )														
( )														
( )														
LOCATION/CONDITION														
FREQ (HZ)														
1/A 1/B 1/C 1/D 1/E 1/F 1/G 1/H 1/I 1/J 1/K 1/L														
63 92 96 98 89 86 86 81 82 82 82 83 83														
125 89 92 99 90 93 93 90 89 88 89 92 90														
250 88 85 100 96 96 97 94 94 93 93 93 94														
500 87 80 101 98 98 99 97 97 96 95 97 97														
1000 92 93 103 101 101 100 97 97 97 97 98 98														
2000 86 81 101 99 99 101 97 95 93 94 96 96														
4000 87 83 108 110 106 101 92 93 94 96 101 96														
8000 88 82 107 103 104 98 87 88 90 91 98 94														
OVERALL 99 99 113 111 110 107 103 103 102 103 106 104														
IDENTIFICATION: )														
) OMEGA 3.2														
) TEST 76-407-001														
) RUN 01														
) 13 SEP 76														
) PAGE J1														

TABLE: MEASURED SOUND PRESSURE LEVEL (DB)												
OCTAVE BAND												
IDENTIFICATION:												
2												
NOISE SOURCE/SUBJECT: ( OPERATION: )												
A-7D AIRCRAFT												
INFLIGHT NOISE LEVELS												
PAGE J2												
LOCATION/CONDITION												
FREQ (HZ)	1/N	1/N	1/P	1/R	1/S	1/T	1/U	1/V	1/W	1/X	1/Y	
63	92	89	93	88	92	90	88	87	91	90	97	
125	95	94	99	97	97	90	95	96	98	97	91	
250	106	103	105	102	102	96	100	100	103	104	91	
500	107	106	109	104	104	95	104	104	108	106	88	
1000	106	105	107	106	105	94	106	107	111	104	94	
2000	101	99	101	100	101	91	102	102	105	100	87	
4000	96	95	97	98	99	88	106	104	107	103	84	
8000	95	94	95	95	98	83	103	104	107	101	83	
OVERALL	112	111	113	110	110	101	112	112	115	111	101	



TABLE: MEASURES OF HUMAN NOISE EXPOSURE													IDENTIFICATION:
3													OMEGA 3.2 TEST 76-407-001
NOISE SOURCE/SUBJECT: ( OPERATION: )													RUN 01
A-7D AIRCRAFT ( )													13 SEP 76
INFLIGHT NOISE LEVELS ( )													PAGE M1
LOCATION/CONDITION													
	1/A	1/B	1/C	1/D	1/E	1/F	1/G	1/H	1/I	1/J	1/K	1/L	
HAZARD/PROTECTION													
C-WEIGHTED OVERALL SOUND LEVEL (OASLC IN DB) AT EAR													
A-WEIGHTED OVERALL SOUND LEVEL (OASLA IN DB) AT EAR													
MAXIMUM PERMISSIBLE TIME (T IN MINUTES) FOR ONE EXPOSURE PER DAY (AFR 151-35, JULY 73)													
NO PROTECTION													
OASLC	98	99	112	111	109	107	103	103	102	102	105	104	
OASLA	96	95	112	112	110	107	102	102	101	102	106	103	
T	60	71	3.8	3.8	5	9	21	21	25	21	11	18	
HGU-2A/P HELMET WITH H-154													
OASLA*	83	80	98	95	95	92	88	88	88	88	91	89	
T	571	960	42	71	71	120	240	240	240	240	143	202	
HGU-2A/P HELMET WITH H-154(A)													
OASLA*	78	77	90	86	87	86	84	84	83	83	84	84	
T	960	960	170	339	285	339	480	480	571	571	480	480	
HGU-2A/P HELMET WITH CUSTOM LINER													
OASLA*	90	89	102	98	99	98	96	95	95	95	96	96	
T	170	202	21	42	36	42	60	71	71	71	60	60	
COMMUNICATION													
PREFERRED SPEECH INTERFERENCE LEVEL (PSIL IN DB)													
PSIL	89	85	102	99	100	100	97	96	95	95	97	97	
ANNOYANCE													
PERCEIVED NOISE LEVEL, TONE CORRECTED (PNLT IN PNDB)													
TONE CORRECTION (C IN DB)													
PNLT	112	111	130	131	127	123	118	116	115	118	121	119	
C	3	4	2	4	2	1	2	1	0	2	1	2	

\* BASED ON CALCULATED SPL SPECTRUM UNDER PROTECTIVE DEVICE.

